Journal of Abnormal Psychology
1993, Vol. 102, No. 2, 288–296

Change in MMPI Scores From College to Adulthood as a Function of Military Service

Paula P. Schnurr, Stanley D. Rosenberg, and Matthew J. Friedman

We examined changes in Minnesota Multiphasic Personality Inventory scores from adolescence to adulthood in a longitudinal study of 540 men who attended college during the Vietnam War. Using change scores that were adjusted for initial values, we compared civilians to veterans who were grouped according to combat exposure: none, peripheral, or direct. In cross-sectional analyses, the groups differed only as adults. Groups were similar in relative stability but differed by multivariate analysis in absolute change on the clinical scales. Only veterans with peripheral exposure differed from civilians in multivariate contrasts, even after controlling for premilitary variables. Effect sizes were small. Results suggest that combat exposure does not produce uniformly negative outcomes and may have positive effects in select populations.

Military service is a significant developmental experience that is perceived by most veterans to have had important effects on their lives (Gade, 1991; Schnurr & Aldwin, in press). For example, over 50% of a group of older veterans saw military service as a major turning point and the reason most frequently cited was that it gave them increased maturity (Elder, Gimbel, & Ivie, 1991). The positive benefits of military service are echoed in recruiting advertisements that portray a military career as a way to "be all that you can be." However, many studies show negative effects, such as increased likelihood of posttraumatic stress disorder (PTSD) in combat veterans (e.g., Card, 1983; Centers for Disease Control, 1989; Green, Grace, Lindy, Gleser, & Leonard, 1990; Kulka et al., 1988).

One problem in trying to study the effects of military service is that individuals are not randomly assigned to enter the military or to the types of experiences they have while enlisted. Some researchers have attempted to control for this problem by using retrospective accounts of premilitary characteristics as covariates in analyses of postmilitary outcomes (e.g., Kulka et al., 1988). Although this strategy is preferable to unadjusted analysis, it is subject to retrospective distortion (e.g., analyses of data collected at service entry and after repatriation from Air Force crewmen who had been prisoners of war (POWs) in Vietnam showed that those who thought they had benefited from captivity did not improve in psychological function any more than those who reported no benefit; Ursano, Wheatley, Sledge, Rahe, & Carlson, 1986).

We have found two longitudinal studies that used nonretrospective sources of premilitary data to investigate the psychological outcomes of military service. Card (1983) examined self-reports of 10 traits in male Vietnam veterans, Vietnam-era veterans, and civilians in their mid-30s who initially had been studied in high school during the 1960s. The only change observed was in era veterans, who increased in sensitivity to others' needs. Elder and Clipp (1989) studied male World War (WW) II and Korean conflict veterans who had been subjects in ongoing longitudinal studies since adolescence. Heavy combat veterans were more likely than those with light or no exposure to have negative memories of military service and to report stress symptoms at age 55 but had the greatest positive changes from adolescence to midlife in Q-sort measures related to coping: increases in ego resilience and decreases in helplessness.

Many investigators have used the Minnesota Multiphasic Personality Inventory (MMPI) to study the psychological outcomes of military service, especially in Vietnam veterans. Wheatley and Ursano (1982) found that POWs had elevated scores when tested at repatriation and again 2–5 years later. Mean scores initially were elevated within the normal range on Scales K, 1, 2, 3, 5, 6, and 9 but decreased slightly over time. The Centers for Disease Control (1989) tested a random sample of male veterans in their mid- to late-30s who had served either in the Vietnam War theater or during the Vietnam era. Mean T-scores were within the normal range (<70), and theater veterans had slight elevations on scales 1, 2, 3, 7, and 8. Spike 2 and 2-7-8 code types were more common in theater vets but were relatively rare. Collapsed across code types, likelihood of elevation was greater only in men with moderate to heavy exposure, relative to men with minimal exposure. Men with light exposure were nonsignificantly less likely than the minimal group to have elevations on 4 of the 10 clinical scales.

Paula P. Schnurr and Matthew J. Friedman, Department of Psychiatry, Dartmouth Medical School, National Center for PTSD; Stanley D. Rosenberg, Department of Psychiatry, Dartmouth Medical School.

This research was supported by a grant from the U.S. Department of Veterans Affairs to Matthew J. Friedman and Stanley D. Rosenberg. A version of this article was presented at the annual meeting of the Gerontological Society of America in San Francisco, California, November 1991.

We would like to thank Carolyn Aldwin, Edward Blanchard, Elizabeth Clipp, Glen Elder, Jr., Terence Keane, Ilene Siegler, and Avron Spiro, III, for their thoughtful and helpful comments on a previous version of the manuscript. In particular, Avron Spiro provided many suggestions about the data analyses and the use of change scores. We also thank Sheila Vowinkel for assistance in data collection and data management.

Correspondence concerning this article should be addressed to Paula P. Schnurr, National Center for PTSD (116D), VA Medical and Regional Office Center, White River Junction, Vermont 05009.

Some investigators have used the MMPI to study PTSD in treatment-seeking (e.g., Burke & Mayer, 1985; Fairbank, Keane, & Malloy, 1983; Keane, Malloy, & Fairbank, 1984; McCormack, Patterson, Ohlde, Garfield, & Schauer, 1990; Merbaum & Hefez, 1976; Silver & Salamone-Genovese, 1991) and non-treatment-seeking (Butler, Foy, Snodgrass, Hurwicz, & Goldfarb, 1988; McCormack et al., 1990) populations. In general, these studies show that combat veterans with PTSD have a distinctive pattern of elevation (F-2-[7]-8) on the MMPI, even when they have not sought treatment for the disorder. Also, a PTSD scale has been derived from the MMPI for use in both clinical (Keane et al., 1984) and community (Kulka et al., 1988) populations.

It is difficult to understand these data in the context of normal developmental trends on the MMPI because there have been few long-term studies of the MMPI in nonclinical populations. In those that do exist, the emphasis has been on relative change, usually as indexed by test–retest correlations, rather than on absolute change, as in the studies reviewed above. Leon, Gillum, Gillum, and Gouze (1979) found moderately high relative stability on the 13 basic MMPI scales between ages 50 and 80 in men (average $r = .43$), and mean increases occurred on all scales except L. Finn (1986a) compared relative stability of 15 MMPI factors over 30 years in Leon et al.'s (1979) sample and a sample of men who had been 17–25 years old at initial testing. Average test–retest correlations were higher in the older group (.53) than the younger group (.38). Factors related to the higher-order factor Constraint tended to be more stable in the older group, but Finn (1986b) found that stability of the factor structure was similar in both. He did not report absolute change, thus leaving open the question of what mean normative changes occur from adolescence to adulthood on the MMPI.

It is clear that additional longitudinal research using standard measures is needed in order to understand the psychological outcomes of military service. We addressed this need by looking at change in MMPI scores from late adolescence to adulthood in a group of men who attended Dartmouth College during the Vietnam War era. The study is distinctive because we know little about how relatively privileged men react to military service. The study also is distinctive because we have information about psychological adjustment in combat veterans prior to their military service. Observations of change subsequent to military service are therefore free from retrospective biases. It is fortunate that our premilitary data are MMPI scores. The MMPI has been used widely in other studies of Vietnam veterans, but no one has reported longitudinal data on the basic MMPI scales from college to adulthood in a nonclinical sample.

Our aim was to determine the direction and amount of change as a function of military service history. We computed a measure of change that was adjusted for initial values in order to avoid the problems caused by simple difference scores (Cohen & Cohen, 1983). We used these adjusted change scores to compare civilians to veterans, who were grouped according to progressively increasing amounts of combat exposure: none, peripheral, or direct. The change analyses were supplemented by cross-sectional comparisons in order to provide information about starting and ending points. Although our primary purpose was to analyze absolute change as a function of military service history, we also examined relative stability in the MMPI scores between college and adulthood.

Based on the MMPI literature, we expected modest relative stability overall, but had no basis for making predictions about how the groups might differ from each other. We also did not have a firm basis for making predictions about absolute change. Elder and Clipp's (1989) findings with an older sample suggest that direct combat veterans might show the most positive change. However, studies of Vietnam veterans lead us to predict the most negative change (largest increases or smallest decreases) in direct combatants, especially on scales F, 2, 7, and 8. Card's (1983) data suggest that noncombatants would show the most positive change (smallest increases or largest decreases). A straightforward prediction for the peripheral combat veterans is that they would fall somewhere between the noncombat and direct combat veterans. Alternatively, we wondered if the peripheral group would experience the most positive change because their exposure to some aspects of combat could have provided a unique opportunity to enhance coping skills, self-reliance, and self-esteem without the consequences typically associated with greater exposure.

Method

Subjects

Subjects were drawn from a pool of 1,483 surviving members of the all-male Dartmouth College classes of 1967 and 1968 for whom a recent address was available. The pool represented 90% of those originally enrolled. Of the 739 respondents to our survey, 716 provided their name and gave permission for us to search college records to obtain data necessary for the study. Of these men, 584 provided complete data, but 30 were excluded because of MMPI profile invalidity (>30 missing items at either administration), and 14 were excluded because they were conscientious objectors or refused induction.

The 540 remaining men averaged 39.8 years of age at the time of the study (range = 36–43 years). We did not ask subjects to identify their ethnic identity, but college records show that over 98% of the classes of 1967–1968 were white. Most (83%) were married, and 67.8% held a professional or an executive job. Almost half (49.1%) served in the military during the Vietnam War.

Of the veterans, 42.6% had been in the Vietnam theater of operations. Most veterans served in the Army (42.6%) or the Navy (27.8%); the remainder served in either the Reserves (11%), Air Force (6.8%), Marines (6.5%), National Guard (2.7%), or Coast Guard (2.7%). Almost 14% had been drafted. When asked to rate their combat exposure on a 3-point scale as either "no exposure," "peripheral," or "direct" (no further definition was provided on the questionnaire), just over 23% reported peripheral exposure and 17.4% reported direct exposure.

We were concerned that our participants' current state might undermine the validity of these retrospective reports of combat exposure. Therefore, we attempted to validate the distinction between the groups with information about military service that might be considered to be less subject to reporting bias. We found that the groups differed in ways that would be expected of soldiers who actually differed in their combat exposure. According to the method described by Fleiss (1981) for testing qualitatively ordered proportions (indicated here as χ^2 order), there was a positively increasing association between amount of combat exposure and presence of several variables that have been shown by Kulka et al. (1988) to be risk factors for PTSD. Only 6.4% of the noncombatants served in the Vietnam theater of operations as opposed to 91.9% of the peripheral and 100% of the direct combat groups, χ^2 order

(c = .55, N = 265) = 207.8, $p < .001$. The percentage of men who had been drafted was 11.8% in noncombatants, 8.2% in peripheral combatants, and 28.9% in direct combatants, χ^2 order (c = .55, N = 259) = 14.05, $p < .001$. The percentage who served in the Army or Marines was 39.4% in noncombatants, 51.6% in peripheral combat veterans, and 78.3% in direct combat veterans, χ^2 order (c = .55, N = 263) = 21.7, $p < .001$.

We also validated our combat classification by examining data from a multiitem combat exposure scale (Card, 1983) that was sent to men who reported combat exposure on the screening questionnaire and who were part of a smaller group sampled for an interview study (Schnurr, Friedman, & Rosenberg, 1993). The scale consisted of the sum of nine items that covered such events as receiving fire, firing a weapon, exposure to death and injury, and killing the enemy. The items were scored with 0 = "never" and 4 = "very often" (unlike the 1–5 scoring used in Card's study). The means (*SD*s) in the peripheral and direct groups were 4.32 (3.68) and 13.64 (5.34), respectively, effect size = 1.45, $t(73.12) = 9.87$, $p < .001$. The direct group reported more exposure than the peripheral group on each individual item as well, even when the items were scored as "ever" versus "never" (all $ps < .01$). For example, 84.1% of the direct group but only 23.6% of the peripheral group reported having ever fired a weapon, χ^2 (1, N = 99) = 35.7, $p < .001$. We were especially encouraged by the magnitude of differences between the peripheral and direct groups when the items were scored dichotomously, because bias might be expected to exert less influence on reports of whether an event occurred than on the extent to which it occurred.

Based on military service and combat exposure, we divided the men into four groups: civilians (n = 275), noncombat veterans (n = 157), peripheral combat veterans (n = 62), and direct combat veterans (n = 46).

Procedure

Subjects completed the MMPI (Group Form) as freshmen during orientation in 1963 or 1964, depending on their class; only transfer students and a few foreign students did not take the test. College records provided *K*-corrected *T*-scores for the validity and clinical scales as well as information about grade point average (GPA), paternal occupation and education, Scholastic Aptitude Test (SAT) scores, and reprimands for disciplinary infractions or academic performance.

Between 1984 and 1987 we administered by mail the MMPI (Group Form) and a brief questionnaire. The questionnaire included items about military service history such as branch of service and combat exposure, political attitudes during the Vietnam War, and current marital and occupational status.

Data Analysis

K-corrected *T*-scores were computed for the MMPI validity and clinical scales so that the adult data would correspond to the college data. *T*-scores ≥ 70 were considered to be clinically elevated. All analyses are based on *K*-corrected *T*-scores except as noted. Non-*K*-corrected raw college and adult scores were computed for use in selected analyses because *K*-correction can be nonoptimal in normal populations (Colby, 1989; McCrae, Costa, Dahlstrom, Barefoot, Siegler, & Williams, 1989).

Multivariate analysis of variance (MANOVA) was used for the analysis of MMPI data in order to minimize the probability of Type I error. Given differences between the constructs assessed by the clinical and the validity scales (i.e., response style vs. psychological functioning), we analyzed data from each set of scales separately. Box's *M* test was used to test the homogeneity of variance–covariance matrixes, and none of these tests indicated marked heterogeneity. Pillai's criterion was used for the multivariate *F*-tests. A *p*-value of .05 was used as the criterion for statistical significance in all analyses.

If found, a statistically significant multivariate effect of military history group was explored by a series of three planned comparisons that treated civilians as a reference group and progressively assessed the effects associated with increasing exposure to war-zone trauma: civilians versus noncombat veterans, veterans with peripheral combat exposure, and veterans with direct exposure, respectively. Univariate comparisons were performed only for multivariate comparisons that were statistically significant; two exceptions to this rule are noted below.

For the analyses that focused on absolute change, a residualized change score was computed for each MMPI scale.[1] An individual's college score was subtracted from his adult score so that a positive difference would indicate an increase over time. Potential effects of baseline values were removed by regressing the change scores on college scores and using the residuals from the analysis as a dependent variable in subsequent analyses (Esrey, Casella, & Habicht, 1990). First, however, the residuals were converted to their original scale of measurement by adding them to the grand mean of the (unadjusted) change scores. These residualized scores measure the amount of change assuming that all subjects had the same college scores and thus adjust for the effect of preexisting personality differences between our military history groups. By adjusting for initial values, we eliminated the problems often caused by the use of simple change scores (Cohen & Cohen, 1983). In fact, estimates of the effect of the independent variable (i.e., military history group) are the same as if we had adjusted adult scores for college scores (see Cohen & Cohen, 1983).[2]

Logistic regression was used to examine change in the likelihood of having a profile with a clinically elevated score. Civilians were treated as the reference group for computation of odds ratios (ORs) and 95% confidence intervals (CIs).

The relative stability of individuals over time was examined first by Pearson correlations between college and adult MMPI scores in the sample as a whole. Differences between groups in relative stability were tested as in Finn (1986a). For each scale, we performed a multiple regression analysis in which the adult score was treated as the dependent measure and the college score, group (dummy coded), and the Group × College interaction were treated as predictors. These analyses

[1] Given the correlational nature of our design, this approach is preferable to analyzing the college and adult scores in a Group × Time repeated-measures analysis of variance (ANOVA) and interpreting the Group × Time interaction as evidence of between-group differences in change. Cook and Campbell (1979) explain the reason in their discussion of the two-step ANOVA procedure that is sometimes used instead of the Group × Time design (i.e., examining Time 1 differences and, failing to find any, examining Time 2 as evidence of change). Both approaches are based on the incorrect assumption that failure to find differences between groups in Time 1 scores indicates equivalence and allows subsequent differences to be interpreted as resulting from the independent variable that defines group membership. The problem is that nonrandomly assigned groups may differ over time, not because of the influence of the independent variable that defines group membership but because of selection-maturation. If the maturational process has not had sufficient time to unfold, initial mean differences might not be detected and will be falsely interpreted as having no relation to subsequent differences.

[2] Cohen and Cohen (1983) actually use this equality in order to support an argument in favor of simply partialling the effect of a baseline measure from one collected at a subsequent time. However, we have chosen change rather than adult scores as our dependent measures because we wish to focus on the amount and direction of change in our groups rather than on how they appear as adults.

also provided a check on the assumption of homogeneity of regression for the analyses used to create the residualized change scores; in each case, a nonsignificant interaction indicates that the assumption is not violated.

Results

We assessed how well our sample of 540 men represented the potential subject pool by comparing their college MMPI scores with the scores of a group of 552 unselected subjects: 175 respondents who were not included for one of the reasons stated above but for whom we had permission to access college records and 377 nonrespondents from the class of 1968. Nonrespondents' data were taken from an existing data set that did not require us to identify individuals by name for score retrieval; a similar data set for the class of 1967 was not available.

A MANOVA on the validity scales showed a statistically significant difference between our sample and the unselected men, $F(3, 1088) = 3.47$, $p < .05$, due primarily to a small but statistically significant univariate difference on the Lie Scale, means = 46.1 and 47.0, respectively; $F(1, 1090) = 6.92$, $p < .01$. Although there was no multivariate effect on the clinical scales, $F(10, 1081) = 1.13$, *ns,* we examined the univariate tests because college differences on the clinical scales could compromise the interpretation of adult differences. Fortunately, there were no univariate differences on the clinical scales, even though the tests had more than 90% power to find an effect size as small as .20. Taken together, these analyses suggest that our sample was highly representative of the group from which they were drawn in terms of college MMPI scores.

Cross-Sectional Analyses

In order to provide a context for interpreting our change scores, we first examined cross-sectional differences between groups (see Figures 1 and 2). Mean scores at both times were within the normal range; elevations on Scale 5 are consistent with the educational and socioeconomic background of the sample.

MANOVAs at each time point suggest divergence rather than convergence of the groups over time. The groups did not differ from each other in college on either the validity or the clinical scales (both multivariate *F*s were < 1). In adulthood, the groups still did not differ on the validity scales, multivariate $F(9, 1608) = 1.29$, *ns,* although they did on the clinical scales, multivariate $F(30, 1587) = 1.60$, $p < .05$. The pattern of means suggests that, relative to civilians, peripheral combat veterans had the lowest scores and direct combat veterans had the highest scores. However, planned comparisons showed that only the contrast of civilians versus veterans with peripheral combat exposure was statistically significant, multivariate $F(10, 527) = 2.05$, $p < .05$. Veterans with peripheral exposure had lower scores than civilians on Scales 1 and 3, $F(1, 536) = 5.16$, $p < .05$; $F(1, 536) = 4.60$, $p < .05$, and higher scores on Scale 9, $F(1, 536) = 4.36$, $p < .05$). Veterans with peripheral exposure also probably had lower scale scores on Scales 6 and 7, $F(1, 536) = 3.36$, $p < .07$; $F(1, 536) = 3.76$, $p < .06$. The means in Figure 2 show that the magnitude of these differences was small, ranging from 1.6 points on Scale 6 to 3.36 on Scale 9.

We examined univariate differences between direct combat veterans and civilians on scales F, 2, 7, and 8 even though the multivariate contrast failed our significance criterion. The groups did not differ on these scales.

Results of cross-sectional analyses of non-*K*-corrected raw scores were highly similar to the results observed with the *K*-corrected *T*-scores. The only discrepancies were in the univariate contrasts between civilians and peripheral combat veterans for the adult data. The peripheral combat veterans did not differ from civilians on Scales 1 and 7 (both *F*s < 1) but may have had lower adult scores on Scale 5, $F(1, 536) = 2.83$, $p = .09$.

As adults, 43.1% of the men ($n = 233$) did not have any clini-

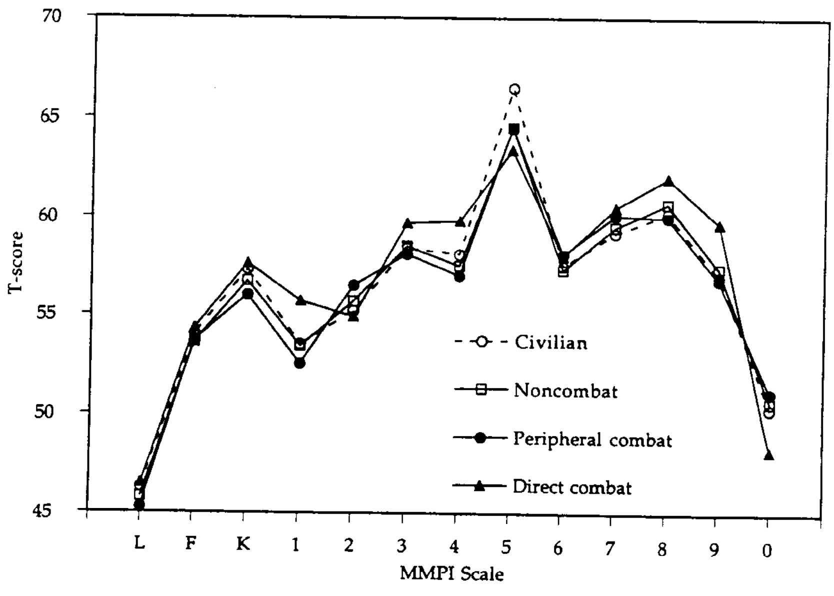

Figure 1. College MMPI T-scores as a function of military service history.

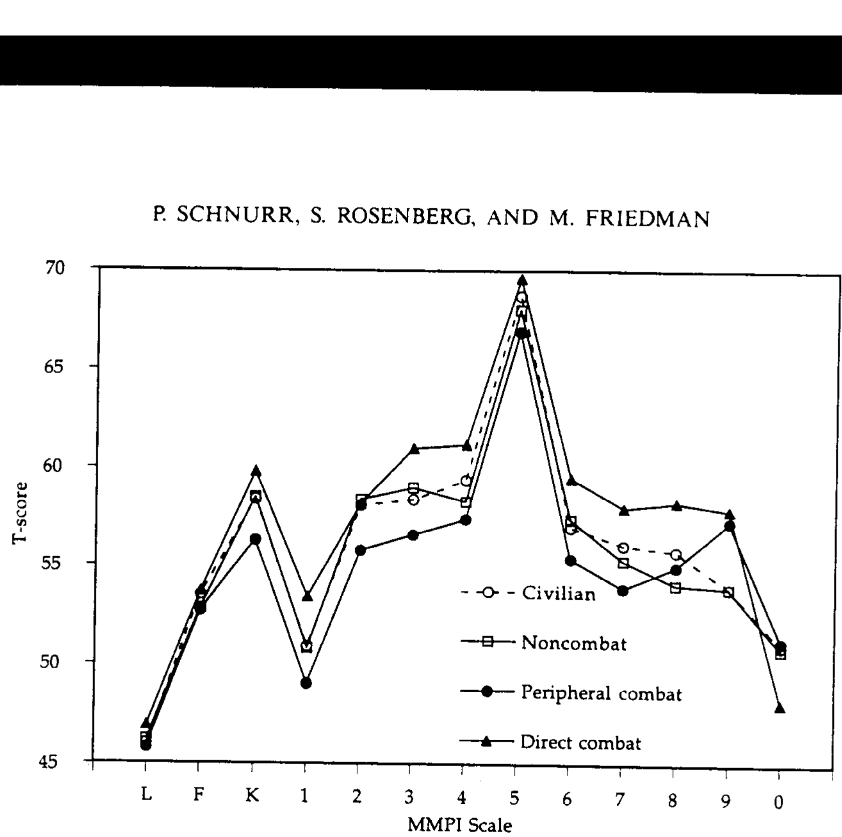

Figure 2. Adult MMPI T-scores as a function of military service history.

cally elevated scale scores, and there were no differences between groups in likelihood of elevation, $\chi^2(3, N = 540) = 1.51$, *ns.* The most frequently occurring code types involved Scale 5 (36.1%, $n = 195$), typically spike 5. Prevalence of any other single code type was too low to allow statistical analysis. However, we note that the occurrence of 2-7, 2-8, and 2-7-8 code types ranged from 0% in the peripheral group to 2.2% ($n = 1$) in the direct group.

Change Analyses

All correlations between college and adult scores on the clinical and validity scales were statistically significant at $p < .001$. They indicated only modest relative stability, ranging from a low of .19 for Scale 6 to a high of .44 for Scale 5 (median $r = .29$ across all 13 scales). Differences between groups were examined using the regression procedure described above. These analyses showed that the Group × College Score interaction did not significantly predict the adult score for any scale (lowest $p = .13$), thus indicating that the groups did not differ in relative stability.

Table 1 displays the residualized change scores for each MMPI clinical and validity scale as a function of military group. Across groups, the largest increases occurred on Scales 2 and 5, whereas the largest decreases occurred on Scales 7 and 8. The average amount of change ranged from a decrease of almost 5 points on Scale 8 to an increase of just over 3 points on Scale 5. Mean changes within groups were of similar magnitude and reflect the direction in which the majority of individuals moved but do not convey the substantial amount of change experienced by some; on each scale, almost one third of the subjects changed (increased or decreased) one or more standard deviations.

A MANOVA revealed group differences in absolute change, as suggested in the cross-sectional analyses. There was a multivariate effect of military history for the clinical scales, $F(30, 1587) = 1.51$, $p < .05$, but not for the validity scales, $F(9, 1608) = 1.05$, *ns.* Multivariate planned comparisons on the clinical scales showed no difference between civilians and noncombatants ($F < 1$). Civilians differed from veterans with peripheral combat exposure, multivariate $F(10, 527) = 2.05$, $p < .05$. Univariate comparisons between these groups generally showed a pattern of small but relatively greater decreases in scale scores in the peripheral exposure group. For Scales 1, 3, and 7, both groups decreased, but the decrease was larger in the peripheral group, $F(1, 536) = 4.42$, 4.47, and 4.93, respectively, all $ps < .05$; there was a marginally significant difference in this direction for Scale 6 as well, $F(1, 536) = 3.91$, $p = .05$. For Scale 9, however, civilians' scores decreased, whereas the peripheral combat group showed little change, $F(1, 536) = 5.18$, $p < .05$. There probably was a difference on Scale 2, $F(1, 536) = 3.59$, $p < .06$, on which the peripheral exposure group did not change, but civilians actually increased. Univariate effect sizes for all significant effects were small (average $d = .10$).

Although the multivariate contrast on the clinical scales between civilians and direct combat veterans was not statistically significant, $F(10, 527) = 1.35$, *ns,* we examined the univariate tests in order to check our predictions about Scales F, 2, 7, and 8. There were no differences on these scales.

Results of analyses of residualized change in non-*K*-corrected raw scores were highly similar to the results observed with the *K*-corrected *T*-scores. In fact, the only discrepancies were failures of the univariate contrasts between civilians and peripheral combat veterans to attain statistical significance for Scales 1 and 7 in the non-*K*-corrected analyses (both $Fs < 1$).

In order to control for preexisting characteristics (other than college MMPI scores) that could account for the differences observed between groups, we repeated our analyses of the change scores using as covariates the following information taken from college records: father's occupation and education,

Table 1
Mean Residualized Change Scores on MMPI Validity and Clinical Scales as a Function of Military History Group

Scale	Civilian (n = 275)		Noncombat (n = 157)		Peripheral combat (n = 62)		Direct combat (n = 46)		Total (n = 540)	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
L	−0.08	5.36	0.19	5.02	−0.09	6.05	0.72	6.52	0.07	5.44
F	−0.37	5.34	−1.01	5.54	−1.14	6.05	−0.24	5.00	−0.64	5.45
K	1.21	7.24	1.49	7.75	−0.37	8.20	2.53	8.38	1.22	7.62
1	−2.57	6.99	−2.68	7.74	−4.36	7.22	−0.59	6.70	−2.64	7.25
2	2.69	10.18	2.80	10.29	0.02	11.49	2.89	10.37	2.43	10.39
3	−0.09	7.37	0.48	6.84	−1.83	6.89	2.22	7.32	0.07	7.21
4	1.33	9.14	0.52	9.68	−0.28	10.32	2.64	9.41	1.02	9.46
5	2.85	8.04	3.06	8.29	1.88	7.94	5.04	9.29	2.99	8.22
6	−0.53	8.52	−0.06	6.81	−2.27	6.40	1.82	6.40	−0.40	7.70
7	−3.38	8.54	−4.24	8.44	−5.82	9.89	−1.83	9.24	−3.77	8.77
8	−4.64	8.60	−6.38	9.04	−5.33	9.01	−2.48	10.11	−5.04	8.95
9	−3.32	9.09	−3.48	9.20	0.10	9.44	−0.09	9.83	−2.70	9.30
0	0.67	8.29	0.42	8.93	0.63	8.54	−1.36	8.46	0.42	8.52

Note. Change scores were computed as adult minus college scores, adjusted for college scores. L = Lie, 1 = Hypochondriasis, 2 = Depression, 3 = Hysteria, 4 = Psychopathic Deviate, 5 = Masculinity–Femininity, 6 = Paranoia, 7 = Psychasthenia, 8 = Schizophrenia, 9 = Hypomania, 0 = Social Introversion.

final GPA, SAT scores, and number of academic and behavioral reprimands. The results were virtually identical to the unadjusted analyses because the covariates failed to account for a significant amount of the variance in change scores.[3]

Additional analyses were conducted to assess the clinical significance of the differences between groups in absolute change on the clinical scales, excluding Scales 5 and 0. First, we divided the sample into two subgroups according to the presence versus absence of at least one clinically elevated *T*-score in college. Next, we performed a logistic regression within each subgroup to predict differences between military history groups in change of adult status, relative to no change. The absence of clinically elevated adult scores in those with at least one or more clinically elevated college scores was defined as a "clinically significant decrease" if the amount of decrease on at least one of the initially elevated scales was ≥10 points. Conversely, the presence of one or more clinically elevated adult scores in those with no clinically elevated college scores was considered to be a "clinically significant increase" if the amount of increase on one or more of the currently elevated scales was ≥10 points.[4]

In college, the number of men in each military history group with at least one elevated scale was as follows: civilian (n = 101), noncombat (n = 65), peripheral combat (n = 28), and direct combat (n = 23); the corresponding *n*s for men with no college elevations were 174, 92, 34, and 23, respectively. Based on the change score analyses, we expected that in peripheral combat veterans, clinically significant increases would be less likely and clinically significant decreases would be more likely than in civilians. We also expected some evidence of the opposite pattern in direct combat veterans. These expectations were partially confirmed. Increase in direct combatants was three times more likely than in civilians (43.5% vs. 19.5%, OR = 3.17, 95% CI = 1.28–7.83, $p < .05$). Neither the noncombat (21.7%) nor the peripheral combat group (23.5%) differed from civilians. In contrast, decrease was more likely in peripheral combatants than in civilians (64.3% vs. 38.6%, OR = 2.86, 95% CI = 1.20–6.83, $p < .05$). Noncombatants (55.4%) also were more likely than civilians to decrease (OR = 1.97, 95% CI = 1.05–3.71, $p < .05$). Direct combatants (47.8%) did not differ from civilians.

Discussion

We examined change in MMPI scores from adolescence to adulthood in an attempt to study the psychological outcomes associated with aspects of military service during the Vietnam War era. Our sample was drawn from men who attended an Ivy League college, a factor that may limit our ability to generalize to less select populations but that also allowed us to observe the effects of combat exposure in men who might be expected to be at low risk for poor outcomes. By having access to premilitary MMPI scores, we were able to control for the effect of retrospective bias on memory for premilitary characteristics, and by using these scores to adjust estimates of change, we were able to control for the effect of naturally occurring differences between groups in premilitary MMPI scores.

We found that serving in the military without experiencing combat seemed to have little effect on either change scores or adult profiles. Unlike others (e.g., Green et al., 1990; Kulka et al., 1988), we did not observe profoundly negative outcomes of combat exposure. Direct exposure seemed to have little effect, and peripheral exposure to combat was associated with positive change. The amount of absolute change was small, but peripheral combat veterans who had at least one elevated score in college were more likely than civilians to experience a clinically significant decrease. The effects associated with peripheral

[3] We have reported the unadjusted analyses in greater detail because missing data further reduced our sample size by 10 cases in the adjusted analyses.

[4] The small number of elevated scores on any given scale prevented us from testing for significant increases and decreases on each scale separately.

combat exposure appeared to reflect changes that occurred during or after military service. Differences were maintained (and actually were slightly increased) when we controlled for indicators of adolescent socioeconomic status, academic aptitude, academic performance, and behavior problems in college. Also, cross-sectional analyses indicated that peripheral combat veterans differed from civilians only in adulthood when the veterans had relatively lower scores.

These findings may seem surprising in light of the adverse impact of combat on many Vietnam veterans (e.g., Card, 1983; Centers for Disease Control, 1988; Green et al., 1990; Kulka et al., 1988). However, Elder and Clipp (1989) argue that combat can have positive effects because "coping with challenging situations builds confidence and resources for dealing with demanding circumstances in the life course, especially in relation to loss experiences" (p. 317). This brings to mind the process of "stress inoculation," according to which mastery is gained by progressively greater amounts of exposure to a stressor (Epstein, 1983); Dienstbier (1989) describes a similar process of "physiological toughening" in which progressively greater mastery of stressful situations is facilitated by alterations of neurobiological responses. Both of these principles emphasize the potential salutary effects of exposure to stress, an idea that is supported by studies in the stress literature (Aldwin & Stokols, 1988). For example, Harel, Kahana, and Kahana (1988) emphasize the diversity of outcomes among Holocaust survivors and note that many survivors are well adjusted.

We speculate that the likelihood of positive effects subsequent to combat exposure is related to the likelihood of successfully coping with the potential mastery experiences that combat can provide. Aldwin and Stokols (1988) note that both the context (e.g., stressor severity and timing) and the person (e.g., coping skills and social support) are important in determining reactions to stressors. Following their lead, we suggest that peripheral combat exposure may have positive developmental effects because it provides a context in which an individual is confronted with challenges that typically would not be encountered in the course of civilian life but that many individuals could meet successfully. One might be tempted to postulate that direct combat exposure could yield the same or even greater benefits, but we suspect that for many people, combat generally overwhelms their coping capacity, resulting in failure rather than success and negative rather than positive outcomes.

How can we reconcile these results with Elder and Clipp's (1989) finding that relatively favorable later-life psychological outcomes occurred among heavy rather than light combat veterans? Of course, the MMPI may be tapping entirely different domains of functioning than those represented in Elder and Clipp's Q-sort, but we wonder if differences between the WWII and Vietnam War eras could have differentially influenced the meaning of combat for veterans within these cohorts.

Still, Dartmouth Vietnam veterans with direct exposure to combat did not seem to be as adversely affected by their experiences as might have been expected (e.g., Green et al., 1990; Kulka et al., 1988). One possibility is that factors inherent in the select nature of this group—primarily white men who attended an Ivy League college—may have protected them from the potentially traumatic effects of extensive combat exposure. In fact, their educational attainment may have been critical in this regard, because education serves as a protective factor in decreasing the risk of PTSD and other negative psychological outcomes in traumatized populations (Green et al., 1990; Harel et al., 1988; Kulka et al., 1988). The select nature of the sample also may explain the small size of the effects observed for peripheral combat exposure.

By itself, the experience of combat, relative to no exposure, seems to have had virtually no effect on our sample: If the peripheral and direct groups were pooled, there would be no differences between combat veterans and civilians in adult scores or change scores; a similar lack of difference would be observed if we compared all Vietnam veterans to civilians.[5] Thus, the validity of the distinction between "peripheral" and "direct" exposure is critical to the interpretation of our findings. We validated our exposure scale by examining data from a multi-item exposure scale and data on aspects of military service that are known correlates of PTSD, which has been found to correlate in a dose-response fashion with combat exposure (e.g., Green et al., 1990; Kulka et al., 1988). Nevertheless, retrospective self-reports such as our combat exposure scale can be influenced by both error and bias. An alternative interpretation of our findings is that the apparent difference between peripheral and direct combat veterans could have resulted from a tendency for those who currently feel relatively worse to overestimate their exposure and those who feel relatively better to minimize their exposure. If true, this hypothesis in its most general sense implies an artifactual basis for the consistently demonstrated relation between psychological symptoms (e.g., distress, depression, PTSD) and exposure to traumatic events (e.g., combat, natural disaster, assault).

However, we think this hypothesis is unlikely for several reasons. One is that McFarlane (1988) found that bias in retrospective reports of a traumatic event seems linked to the occurrence of symptoms following the event rather than to the psychological state at the time the event is retrospectively reported. He studied individuals who were exposed to a natural disaster 4 and 11 months after their exposure. At 11 months, those who did not experience psychiatric symptoms at either time tended to underreport trauma relative to their 4-month reports. In contrast, recall of trauma at 11 months was more accurate among those who had experienced symptoms at 4 months, regardless of whether they still had symptoms at 11 months (i.e., accuracy was as high among those whose symptoms had remitted as among those who remained symptomatic). If the psychological state at 11 months had biased recall accuracy, the remitted group would have been less accurate like the never-symptomatic group.

Another reason why we think that bias in reports of combat exposure is an unlikely explanation for our results is that retrospective combat scales correlate with military record indicators (Janes, Goldberg, Eisen, & True, 1991; Kulka et al., 1988; Watson, Juba, & Anderson, 1989). For example, Watson et al. (1989) found that four of the five scales they studied were correlated (rs = .40–.54) with at least one of the two military record indicators they examined. Such associations indicate that retrospective reports of exposure are not necessarily invalidated by one's

[5] Details of these analyses are available from the first author.

current state at the time of report. The Janes et al. (1991) 5-point scale has excellent 2-year test–retest reliability (kappa = .84), a property that would tend to be attenuated if the current state significantly biased reports of exposure. Data from the interview phase of this project (Schnurr et al., 1993) also decrease the likelihood that our results were artifactually produced by biased reports of combat exposure. We found that combat veterans who currently have the most symptoms of PTSD reported nonsignificantly less exposure than combat veterans with fewer symptoms or who were asymptomatic.

Correlational analyses showed relative instability between adolescence and adulthood. This instability is comparable to observations in studies that have followed adolescents or young adults as opposed to older adults (Siegler et al., 1990). More notable, perhaps, is the fact that our military history groups did not differ in relative stability. It seems that military service differentially influences absolute change only and that the period from adolescence to adulthood is relatively unstable, regardless of military service. This point is reinforced by the dramatic amount of absolute change in some men.

All of the between-group differences and a substantial amount of the change experienced by individuals occurred within the normal range of MMPI *T*-scores. Although our general conclusions—that peripheral combat exposure is associated with positive outcomes and direct exposure is somewhat associated with negative outcomes—also were supported by analyses of change in likelihood of clinically significant elevation, it is reasonable to consider the meaning of normal-range scores. According to Graham and McCord (1985), normal-range elevations have distinctive trait correlates that are not necessarily lesser versions of the psychopathology indicated by clinically elevated scores. For example, the relatively greater decrease in the peripheral combat exposure group on Scale 1 may not reflect decreases in somatic concerns or symptoms but rather decreases in being hurried, resentful, and boastful. In any case, a decrease within the normal range typically would not be seen as a clinically significant improvement in functioning or well-being, although we suspect that most readers would see it as more favorable than an increase of the same magnitude. Thus, we think it may be best to interpret our results as indicating change within the spectrum of normal psychological function rather than as change in psychopathology only.

Several other issues are relevant to the interpretation of our findings. One concerns the select nature of our sample. We consider this to be a strength but must be cautious in generalizing to all men. For example, the positive effects of military service may be relatively greater for economically underprivileged groups (Schnurr & Aldwin, in press). Another issue concerns the possibility that our sample did not represent the classes from which it was drawn because respondents differed from nonrespondents. Although this may be true, its likelihood is attenuated by the fact that the two groups were highly similar in terms of college MMPI scores. A third issue concerns the nonexperimental nature of our design. Technically, it prevents us from attributing a causal role to combat exposure. Still, we think the evidence is consistent with this interpretation because the MMPI scores of our military history groups were so similar prior to military service and because differences remained when we controlled for a host of premilitary variables.

We have shown that combat exposure accounts for only a small amount of change in MMPI scores from adolescence to adulthood in college-educated men. Future research should attempt to identify other factors that predict both absolute and relative change in psychological function. Also, most studies of military veterans have focused on pathological outcomes. Our findings, along with others (Card, 1983; Elder & Clipp, 1989), suggest the need to consider both positive and negative outcomes in combat veterans and other traumatized populations.

References

Aldwin, C. M., & Stokols, D. (1988). The effects of environmental change on individuals and groups: Some neglected issues in stress research. *Journal of Environmental Psychology, 8,* 57–75.

Burke, H. R., & Mayer, S. (1985). The MMPI and post-traumatic stress syndrome in Vietnam era veterans. *Journal of Clinical Psychology, 41,* 152–156.

Butler, R. W., Foy, D. W., Snodgrass, L., Hurwicz, M., & Goldfarb, J. (1988). Combat-related posttraumatic stress disorder in a nonpsychiatric population. *Journal of Anxiety Disorders, 2,* 111–120.

Card, J. J. (1983). *Lives after Vietnam.* Lexington, MA: Heath.

Centers for Disease Control. (1989). *Health status of Vietnam veterans, Vol. 4: Psychological and neuropsychological evaluation.* Atlanta, GA: Author.

Cohen, J., & Cohen, P. (1983). *Applied multiple regression/correlation analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Erlbaum.

Colby, F. (1989). Usefulness of K correction in MMPI profiles of patients and nonpatients. *Psychological Assessment: A Journal of Consulting and Clinical Psychology, 1,* 142–145.

Cook, D. T., & Campbell, D. T. (1979). *Quasi-experimentation: Design and analysis for field settings.* Chicago: Rand McNally.

Dienstbier, R. A. (1989). Arousal and physiological toughness: Implications for mental and physical health. *Psychological Review, 96,* 84–100.

Elder, G. H. Jr., & Clipp, E. C. (1989). Combat experience and emotional health: Impairment and resilience in later life. *Journal of Personality, 57,* 311–341.

Elder, G. H. Jr., Gimbel, C., & Ivie, R. (1991). Turning points in life: The case of military service and war. *Military Psychology, 3,* 215–231.

Epstein, S. (1983). Natural healing processes of the mind: Graded stress inoculation as an inherent coping mechanism. In D. Meichenbaum & M. E. Jaremko (Eds.), *Stress reduction and prevention* (pp. 39–66). New York: Plenum Press.

Esrey, S. A., Casella, G., & Habicht, J. (1990). The use of residuals for longitudinal data analysis: The example of child growth. *American Journal of Epidemiology, 131,* 365–372.

Fairbank, J. A., Keane, T. M., & Malloy, P. F. (1983). Some preliminary data on the psychological characteristics of Vietnam veterans with posttraumatic stress disorders. *Journal of Consulting and Clinical Psychology, 51,* 912–919.

Finn, S. E. (1986a). Stability of personality self-ratings over 30 years: Evidence for an age/cohort interaction. *Journal of Personality and Social Psychology, 50,* 813–818.

Finn, S. E. (1986b). Structural stability of the MMPI in adult males. *Journal of Consulting and Clinical Psychology, 54,* 703–707.

Fleiss, J. L. (1981). *Statistical methods for rates and proportions,* (2nd ed.). New York: Wiley.

Gade, P. (1991). Military service and the life-course perspective: A turning point for military personnel research. *Military Psychology, 3,* 187–199.

Graham, J. R., & McCord, G. (1985). Interpretation of moderately elevated MMPI scores for normal subjects. *Journal of Personality Assessment, 49,* 477–484.

Green, B. L., Grace, M. C., Lindy, J. D., Gleser, G. C., & Leonard, A. (1990). Risk factors for PTSD and other diagnoses in a general sample of Vietnam veterans. *American Journal of Psychiatry, 147,* 729–733.

Harel, Z., Kahana, B., & Kahana, E. (1988). Psychological well-being among Holocaust survivors and immigrants in Israel. *Journal of Traumatic Stress, 1,* 413–429.

Janes, G. R., Goldberg, J., Eisen, S. A., & True, W. R. (1991). Reliability and validity of a combat exposure index for Vietnam Era veterans. *Journal of Clinical Psychology, 47,* 80–86.

Keane, T. M., Malloy, P. F., & Fairbank, J. A. (1984). Empirical development of an MMPI subscale for the assessment of combat-related posttraumatic stress disorder. *Journal of Consulting and Clinical Psychology, 52,* 888–891.

Kulka, R. A., Schlenger, W. E., Fairbank, J. A., Hough, R. L., Jordan, B. K., Marmar, C. R., & Weiss, D. S. (1988). *Contractual report of findings from the National Vietnam Veterans Readjustment Study* (Contract No. V101(93)P-1040). Research Triangle Park, NC: Research Triangle Institute.

Leon, G. R., Gillum, B., Gillum, R., & Gouze, M. (1979). Personality stability and change over a 30-year period—Middle age to old age. *Journal of Personality and Social Psychology, 47,* 517–524.

McCormack, J. K., Patterson, T. W., Ohlde, C. D., Garfield, N. J., & Schauer, A. H. (1990). MMPI configural interpretation as applied to posttraumatic stress disorder in Vietnam veterans. *Journal of Personality Assessment, 54,* 628–638.

McCrae, R. R., Costa, P. T., Jr., Dahlstrom, W. G., Barefoot, J. C., Siegler, I. C., & Williams, R. B. (1989). A caution on the use of the MMPI K-correction research on psychosomatic medicine. *Psychosomatic Medicine, 51,* 58–65.

McFarlane, A. (1988). The longitudinal course of posttraumatic stress disorder: The range of outcomes and their predictors. *Journal of Nervous and Mental Disease, 176,* 30–39.

Merbaum, M., & Hefez, A. (1976). Some personality characteristics of soldiers exposed to extreme war stress. *Journal of Consulting and Clinical Psychology, 44,* 1–6.

Schnurr, P. P., & Aldwin, C. M. (in press). Military service: Long-term effects on adult development. In R. Kastenbaum (Ed.), *Encyclopedia of adult development.* Phoenix, AZ: Oryx Press.

Schnurr, P. P., Friedman, M. J., & Rosenberg, S. D. (1993). Premilitary MMPI scores as predictors of combat-related PTSD symptoms. *American Journal of Psychiatry, 150,* 479–483.

Siegler, I. C., Zonderman, A. B., Barefoot, J. C., Williams, R. B., Jr., Costa, P. T., Jr., & McCrae, R. R. (1990). Predicting personality in adulthood from college MMPI scores: Implications for follow-up studies in psychosomatic medicine. *Psychosomatic Medicine, 52,* 644–652.

Silver, S. M., & Salamone-Genovese, L. (1991). A study of the MMPI clinical and research scales for post-traumatic stress disorder diagnostic utility. *Journal of Traumatic Stress, 4,* 533–548.

Ursano, R. J., Wheatley, R., Sledge, W., Rahe, A., & Carlson, E. (1986). Coping and recovery styles in the Vietnam era prisoner of war. *Journal of Nervous and Mental Disease, 174,* 707–714.

Watson, C. G., Juba, M. P., & Anderson, P. E. D. (1989). Validities of five combat scales. *Psychological Assessment: A Journal of Consulting and Clinical Psychology, 1,* 98–102.

Wheatley, R., & Ursano, R. J. (1982). Serial personality evaluations of repatriated U.S. Air Force Southeast Asia POWs. *Aviation, Space, and Environmental Medicine, 53,* 251–257.

Received September 4, 1991
Revision received August 13, 1992
Accepted August 25, 1992 ■